

The stroke syndrome of cortical vein thrombosis

K. Jacobs, MD; T. Moulin, MD; J. Bogousslavsky, MD; F. Woimant, MD; I. Dehaene, MD; L. Tatu, MD; G. Besson, MD; E. Assouline, MD; and J. Casselman, MD

Article abstract—Cortical vein thrombosis without sinus involvement is rarely diagnosed, although it may commonly be overlooked. We report four cases of cerebral venous thrombosis limited to the cortical veins. The diagnosis was made on surgical intervention in one patient and by angiography in three patients. Together with a survey of the published cases, the clinical and neuroimaging patterns of our patients allow delineation of several features suggestive of cortical venous stroke. Focal or generalized seizures followed by hemiparesis, aphasia, hemianopia, or other focal neurologic dysfunction in the absence of signs of increased intracranial pressure should suggest this possibility. Neuroimaging (CT, MRI) shows an ischemic lesion that does not follow the boundary of arterial territories and often has a hemorrhagic component, without signs of venous sinus thrombosis. Conventional angiography demonstrates no arterial occlusion but may show cortical vein thrombosis corresponding to the infarct, although these may also be nonspecific findings. The role of MR angiography, which is well-established in sinus thrombosis, remains to be assessed in patients with brain ischemia due to isolated cortical vein occlusion.

NEUROLOGY 1996;47:376-382

Cortical vein thrombosis has seldom been reported.^{1,2} Clinical diagnosis is difficult, and in many cases, it was not made before pathologic verification.^{3,4} Moreover, the term cortical vein thrombosis is sometimes used, confusingly, as a general term for any type of venous thrombosis affecting the brain, including sinus thrombosis. We studied four patients with isolated cortical vein thrombosis whose neurologic features and brain imaging suggest that clinical diagnosis is feasible and should probably be evoked more often.

Patient reports. *Patient 1 (Brugge).* A 38-year-old woman presented with flu-like symptoms, transient blurred vision, and migrating paresthesias 6 months prior to admission in October 1992. Brain MRI, which had been performed in May 1992, was normal. The patient was hospitalized because of progressive numbness and generalized subjective weakness. Physical examination, brain CT, and CSF analysis were normal. During hospitalization, she developed simple partial seizures, with jerking of the left arm and abdominal wall. Carbamazepine was administered. EEG, short latency somatosensory, visual, and brainstem auditory evoked potentials were normal. EEG after sleep deprivation contained intermittent delta and theta waves in the right frontotemporal region. Brain MRI (figure 1A, B) showed a small nodular area in the right parietal region that was hypointense on T₁-weighted images and hyperintense on T₂-weighted images. This area did not enhance after the administration of gadolinium. A slight enhancement was present, however, in the meninges overlying the lesion (figure 1C). Angiography showed non-

specific signs of a space-occupying lesion in the right parietal region. Neither vein occlusion nor collateral venous circulation was reported. Coagulation parameters (including antithrombin III, protein C, protein S, and lupus anticoagulant), *Borrelia* and syphilis serology, angiotensin converting enzyme, rheumatoid factor, and antinuclear antibodies were normal. Control MRI of the brain, performed just before the surgical procedure, showed meningeal enhancement after the administration of gadolinium. At surgery (November 24, 1992), a yellowish area was seen in the right postrolandic cortex. In the center of this area, there was a thrombosed cortical vein, previously emptying into the superior sagittal sinus (figure 1D). Pathologic examination showed a parenchymatous edema, an old venous thrombus partially replaced by fibrous tissue, and signs of recanalization. The postoperative evolution was favorable. Anticoagulants were not given. One year after hospital discharge, the patient developed spondylarthritis, and was found to be HLA-B27 positive.

Patient 2 (Besançon). A 42-year-old, right-handed woman complained of leg pain. Radiculography was performed. After 24 hours the patient complained of an increasingly severe headache. Six days later, she developed intermittent dysarthria. The following day she had a tonic-clonic epileptic seizure. Neurologic examination showed paresis of the right face and arm, visual extinction on double simultaneous stimulation in the right visual field, and global aphasia. Personal history was negative, except for the use of oral contraceptives until 2 years before admission. Coagulation parameters (including protein C, protein S, antithrombin III and antiphospholipid antibodies) and serologic tests (*Borrelia*, syphilis, and HIV) all proved

From the Departments of Neurology (Drs. Jacobs and Dehaene) and Radiology (Dr. Casselman), Algemeen Ziekenhuis St.-Jan, Brugge, Belgium; the Department of Neurology (Drs. Moulin and Tatu), Centre Hospitalier Universitaire Jean Minjoz, Besançon, France; the Department of Neurology (Drs. Bogousslavsky and Besson), Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; and the Departments of Neurology (Dr. Woimant) and Radiology (Dr. Assouline), Hôpital Lariboisière, Paris, France.

Received November 6, 1995. Accepted in final form February 2, 1996.

Address correspondence and reprint requests to Dr. Julien Bogousslavsky, Department of Neurology CHUV, CH-1011 Lausanne, Switzerland.

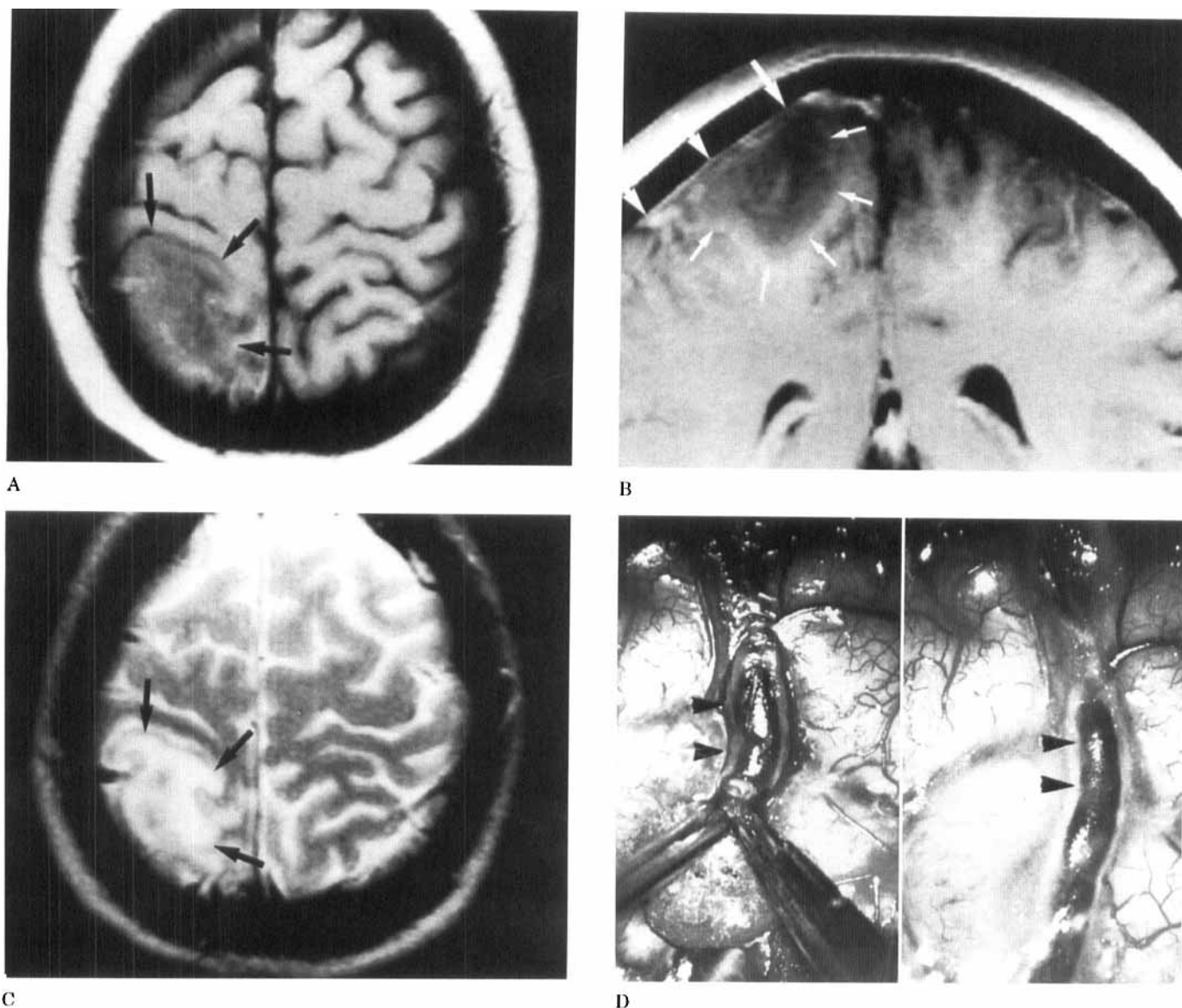
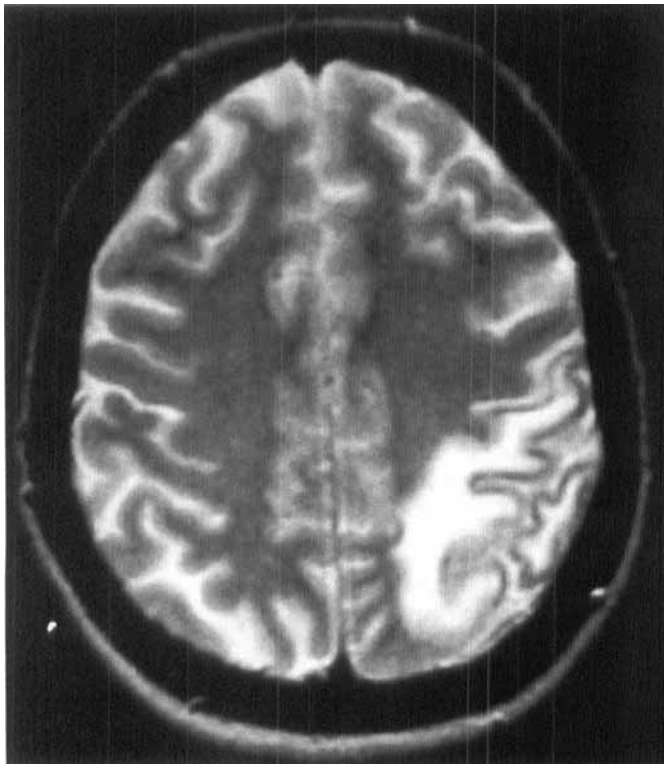


Figure 1. (Patient 1). (A) Axial nonenhanced T_1 -weighted image through the right parietal region. A hypointense area is seen high in the parietal region (arrow). The lesion is pushing the adjacent gyri backward. There is narrowing of the surrounding sulci. (B) Coronal gadolinium-enhanced T_1 -weighted image through the high parietal region. The lesion is hypointense with mass-effect (small arrows). There is no enhancement. Subtle enhancement is present in the meninges overlying the lesion (large arrows). (C) Axial T_2 -weighted image through the high parietal region. The lesion has a high signal intensity on the T_2 -weighted image (arrows). Both white and gray matter are involved and cortical hypointense signal corresponded to a petechial bleeding. (D) Surgical intervention. A thrombosed cortical vein is present in the right perirolandic cortex (arrows).

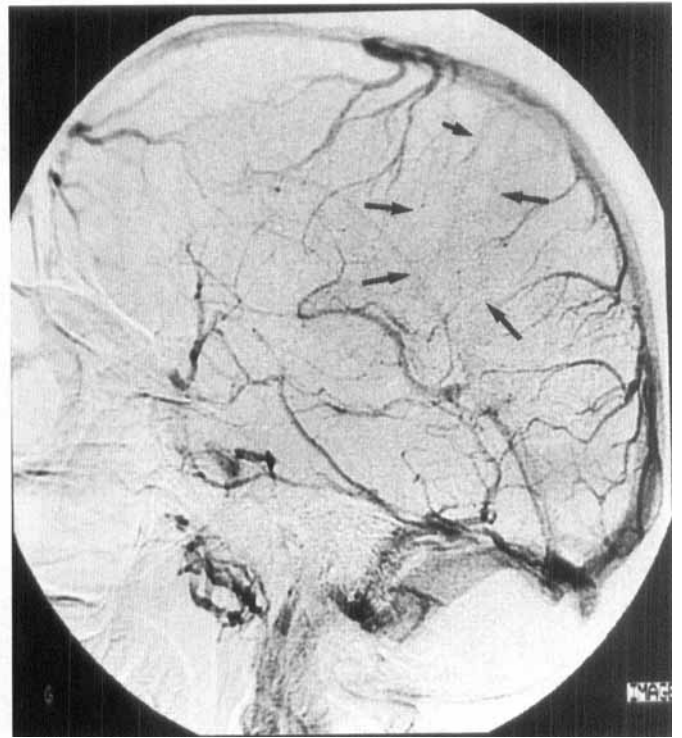
to be normal. CSF protein content was 1.3 g/l, with no immunologic abnormalities. No papilledema was found. On EEG, there were slow waves throughout the left hemisphere. CT showed a hypodense area in the left parietal cortex and underlying subcortical region. MRI confirmed this abnormality, suggesting ischemia with hemorrhagic component (figure 2A). The venous system seemed normal on MRI. No gadolinium was given. Angiography (figure 2B) showed a normal dural sinus morphology, but marked circulatory slowing down in the left cortical veins suggesting thrombosis. Antiepileptic medication (clobazam 20 mg/day) was given. Full-dose heparin was given intravenously for 15 days, followed by oral anticoagulant therapy (INR 3)

for 3 months. On day 2, methylprednisolone (500 mg) was administered intravenously. The patient's condition gradually improved over a period of 1 week. Repeat angiography (figure 2C), performed 3 months later, showed a left parietal cortical vein which was not visible on the previous angiography. Therefore, brain MRI was normal.

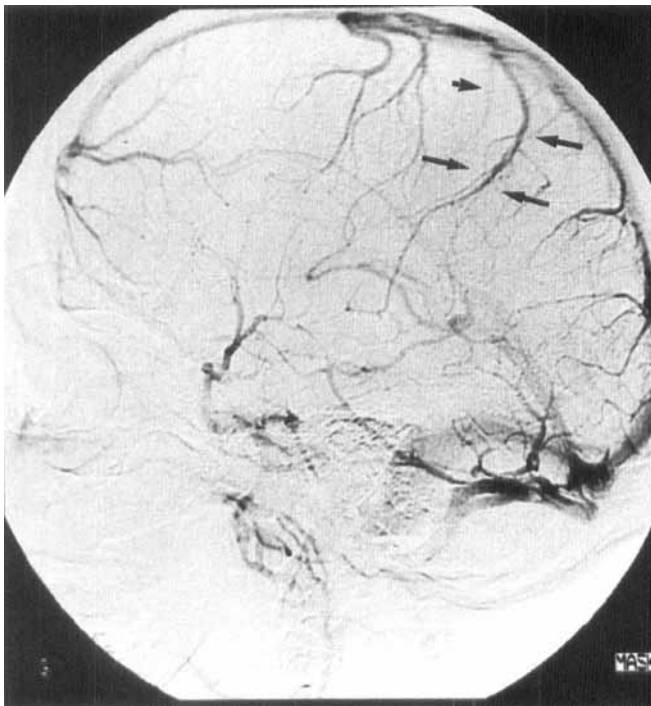
Patient 3 (Lausanne). A 33-year-old, right-handed woman was admitted because of a partial epileptic seizure with right faciobrachial jerking, followed by a headache. Brain CT was normal. There was no papilledema. CSF analysis showed 15 lymphocytes and 8 red blood cells per mm^3 and a protein level of 0.21 g/l. EEG showed intermittent generalized slow waves. Antiepileptic treatment (car-



A



B



C

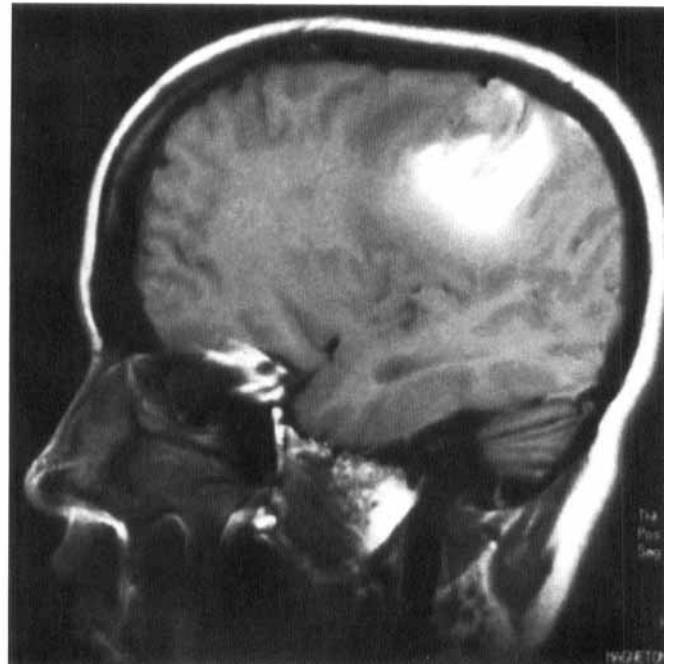
Figure 2. (Patient 2). (A) Axial MRI T₂-weighted image. Hypersignal involving the white matter and located in the parietal region with no mass effect; cortical hyposignal corresponded to a petechial bleeding. (B) Initial angiography shows an interrupted vein (short arrow) and a marked circulatory slowing down (arrows) in the left parietal region. (C) Repeat angiography performed 3 days later shows a left parietal cortical vein that was not visible on the previous angiography (arrows).

bamazepine) was started. Three days later, there was a second partial epileptic seizure with secondary generalization. On day 5, right hemiparesis developed, with memory dysfunction and aphasia. Laboratory tests were normal, including protein C, protein S, antithrombin III, and anti-cardiolipin antibodies, *Borrelia*, syphilis, and HIV serologies, and antinuclear antiRO antibodies. CT on day 7 showed a left parietotemporal hemorrhagic infarction (fig-

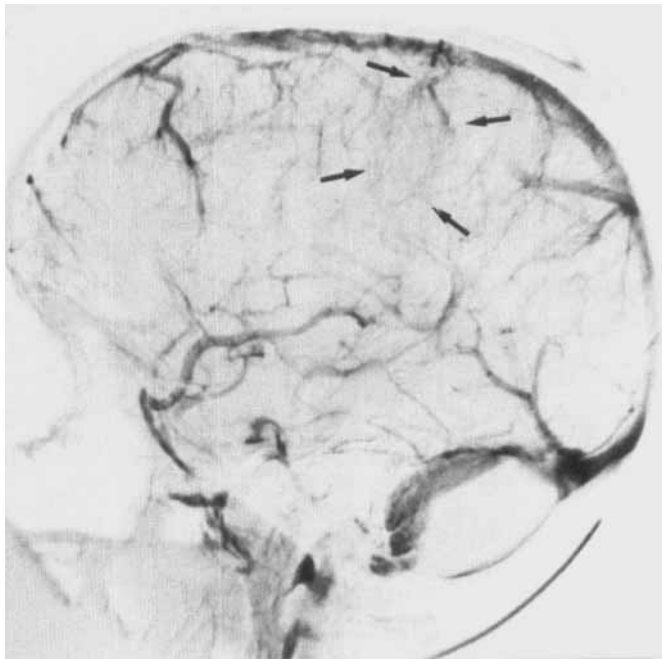
ure 3A). MRI on day 13 confirmed hemorrhagic infarction with no occlusion of the superior sagittal sinus (figure 3B). On angiography (figure 3C) the opacification of the left cortical parietal veins was irregular and interrupted, with no sinus thrombosis. Antiepileptic therapy (phenytoin) was started. Full-dose heparin was given intravenously for 10 days followed by oral anticoagulants for 2 months. The patient recovered dramatically over the first 2 weeks.



A



B

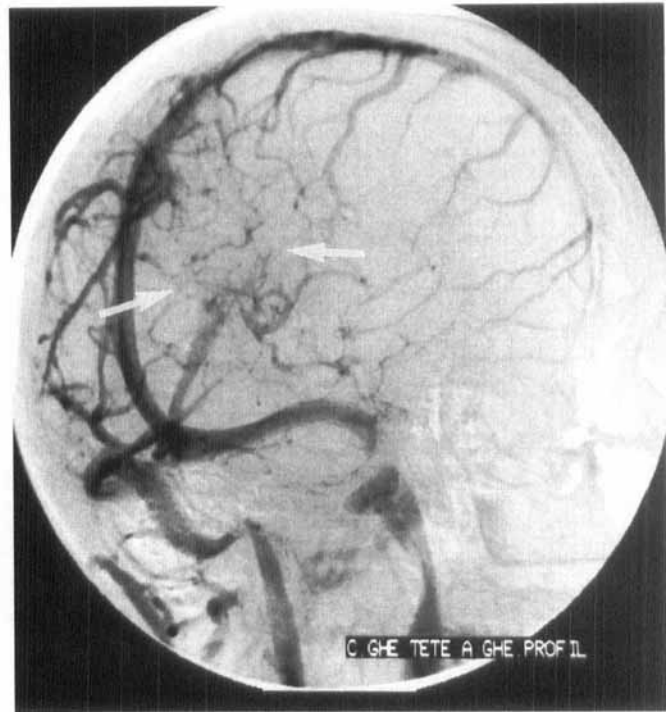
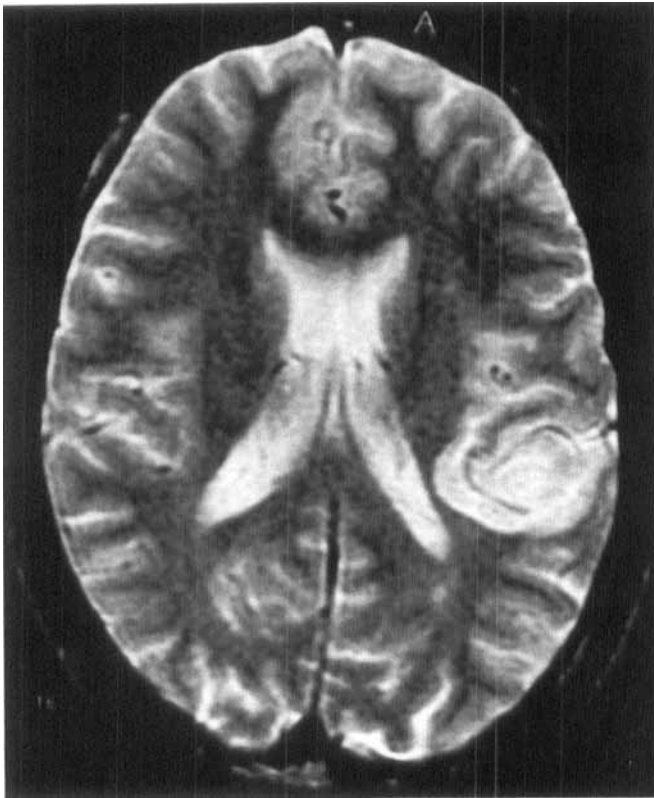


C

Figure 3. (Patient 3). (A) Initial CT shows a left parieto-temporal hemorrhagic infarction with mass effect. (B) Sagittal MRI T₁-weighted image shows hemorrhagic infarct and normal flow in sagittal sinus. (C) Conventional angiography reveals interrupted and irregular opacification of the left cortical parietal veins (arrows).

Patient 4 (Paris). A 33-year-old, right-handed man with Hodgkin's disease (stage IV) had a first chemotherapy (adriamycin, bleomycin, vinblastine, procarbazine, and prednisone). Ten days before, he complained of headache and became aphasic. There was no motor, sensory, or visual deficit. Laboratory tests showed moderate thrombocytopenia. Coagulation tests (including protein C, protein S, antithrombin III, and antiphospholipid antibodies) and serologic tests (syphilis and HIV) were normal. CSF analysis showed 9 lymphocytes and 2,350 red blood cells per mm³ and a protein level of 0.45 g/l. Brain CT showed a hemorrhagic infarction located in left frontoparietal cortex (fig-

ure 4A). T₂-weighted MRI confirmed cortical ischemia and magnetic resonance angiography (MRA) showed a defect of left parietal cortical veins suggesting thrombosis. This was confirmed on conventional angiography. All the dural sinuses were normal (figure 4B). The patient was treated with full-dose heparin, given intravenously for 2 weeks, and then with low-molecular-weight sodium heparin given subcutaneously for 6 months. He recovered in 3 weeks. Chemotherapy was continued, associated with radiotherapy. No other thrombotic manifestation occurred. At 3 years, the patient is in complete remission from Hodgkin's disease.



A

B

Figure 4. (Patient 4). (A) Axial MRI T₂-weighted image confirms the CT and shows a hemorrhagic infarct involving the left frontoparietal region. (B) Conventional angiography reveals interrupted and irregular opacification of left parietal cortical veins. The superior sagittal sinus is patent.

Discussion. In 1880, Raymond¹ gave the first detailed description of cortical vein thrombosis. His work is cited by Garcin and Pestel² in an extensive monograph covering the literature on cerebral vein thrombosis from 1880 to 1946. Subsequently, Yokota et al.³ reported a patient with pure agraphia for Kanji and a hemorrhagic infarct in the left temporal lobe due to thrombosis of the Labbé vein. They referred to two other Japanese cases. Cambria⁴ also reported a patient with thrombosis of the Labbé vein that was related to carbon monoxide poisoning. Among 11 patients with cerebral venous thrombosis, Rao et al.⁵ found two with isolated cortical vein thrombosis documented by CT and angiography. Gabrielsen et al.⁶ reported angiographic findings in eight cases of isolated cerebral vein thrombosis. In six of these cases, thrombosis mainly involved the cortical veins, but there was very limited clinical information. Macchi et al.⁷ reported CT and MRI findings in one patient with parietal vein thrombosis. Milandre et al.⁸ reported two patients with post-partum cortical and infective venous thrombosis who had had a partial seizure with secondary generalization, dyslexia, and dyscalculia. However, in a recent and large series, Ameri and Bousser⁹ reported no case of isolated cortical vein thrombosis among 110 cases of cerebral venous thrombosis.

The clinical features of isolated cortical vein thrombosis are not well known. Review of the litera-

ture and our own cases allow us to describe the main clinical and neuroimaging patterns (table). Although seizures, loss of consciousness, and intracranial hypertension are frequently reported in patients with dural sinus thrombosis, the last two signs may be exceptional in isolated cortical vein thrombosis.^{2,4,5,8} In our patients, partial epileptic seizures were the first signs, and in two patients hemiparesis developed or worsened soon after the seizures. Headaches were present in three patients but without associated signs suggesting intracranial hypertension such as nausea, vomiting, or papilledema. When present altered consciousness was only transient, being linked to seizure generalization, not intracranial hypertension. After acute onset of focal neurologic dysfunction, the picture typically fluctuated in all patients during the first few days or first week.

CSF does not provide specific diagnostic clues,^{9,10} but rules out other possible diagnoses such as meningitis. EEG is not specific and shows only slight lateralized delta slowing without the more dramatic and bilateral changes associated with superior sagittal sinus thrombosis.¹⁰ Exceptionally, unenhanced CT may directly visualize the thrombosed cortical vein ("cord sign").^{5,11} Indirect CT patterns of cortical vein thrombosis are more frequent. Venous infarction should be suspected if the location of the ischemic area does not correspond to a known arterial territory, especially in case of multiple infarcts in the

Table Clinical and neuroimaging patterns of isolated cortical vein thrombosis

Authors	Sex	Age	Headache	Seizures	Focal disturbances	Angiography	Papilledema	CT	MRI	Etiology	Outcome
Cambria et al.* (1980) ⁴	F	50	No	No	Aphasia Right hemiparesis	Defect in left Labbé vein	Yes	No	No	Carbon monoxide poisoning	Good
Macchi et al. (1986) ⁷	F	31	Yes	Yes	No	No	?	Left parietal HI Cord sign	Left parietal HI	?	?
Milandre et al. (1988) ⁸											
Case 13	M	27	Yes	Partial	Hemianopia	Normal	No	Left temporal hypodensity	Left temporal ischemic lesion	Infection	Good
Case 15	F	20	No	Partial	Dyslexia	Defect in left parietal vein	No	Left parietal hypodensity	—	Postpartum	Good
Yokota et al. (1990) ³	M	56	No	Partial	Right hemiparesia Agraphia	Defect in left Labbé vein	?	Left temporal HI	Left temporal HI	?	Good
Our cases											
Case 1*	F	38	No	Partial	No	Normal	No	Normal	Right parietal ischemic lesion	Auto-immune disease	Good
Case 2	F	42	Yes	Partial	Aphasia Right hemiparesis	Defect in left parietal vein	No	Left parietal hypodensity	Left parietal HI	?	Good
Case 3	F	33	Yes	Partial	Right hemiparesis	Defect in left parietal vein	No	Left temporal HI	Left temporal HI	?	Good
Case 4	M	33	Yes	No	Aphasia	Defect in left parietal vein	?	Left frontoparietal HI	Left frontoparietal HI	Hodgkin's disease	Good

* Corresponds to cases with surgical diagnosis.
HI = hemorrhagic infarction; ? = unknown.

same hemisphere.¹⁰ The parietotemporal region might frequently be involved in relation to parietal or Labbé vein thrombosis.^{3,4,7} A hemorrhagic component is frequent in venous infarction.¹² Our cases confirmed these patterns. However, CT may occasionally remain normal.^{5,11}

MRI may have major advantages, although experience with cortical vein thrombosis is limited.⁷ McMurdo et al.¹³ stressed the possibility of false-positive and false-negative images. Indeed, the absence of a signal on the first echo image from a vessel containing flowing blood (bloodflow) may be the result of either dephasing phenomena or time-of-flight. Also, a decreased signal on T₂-weighted images, particularly on units of higher field strength, may be confused with patency. In our patients, MRI did not clearly demonstrate cortical vein thrombosis, but enabled us to evaluate better the location of infarcts and the patency of dural sinus.

Since the number and location of cortical veins are not constant, the diagnosis of isolated cortical vein thrombosis on angiography may also be difficult, except when a partially visualized vein abruptly stops or is surrounded by dilated collateral veins.^{5,6,9} In our cases, the angiographic patterns were typical in patients 3 and 4, suggestive in patient 2, and irrelevant in the first patient. Control angiography in patient 2 dramatically demonstrated a previously absent cortical vein, allowing a late diagnostic confirmation. We made the diagnosis on surgery in the first patient. Despite improvement in MRA techniques, conventional angiography remains indicated until more experience is gained with MRA in this situation.

Ameri and Bousser⁹ and Bousser and Barnett¹⁰ reviewed numerous conditions causing or predisposing to cerebral venous thrombosis. Unfortunately, in up to one-third of the cases, no etiology is found. The etiologic mechanisms in isolated cortical vein or sinus dural thrombosis are probably the same. A systemic disease may lead to extensive dural sinus thrombosis rather than to a limited cortical vein thrombosis. In contrast, a focal lesion, particularly involving the meningeal space, might lead to a limited cortical vein thrombosis.

The anatomic features of cortical vein circulation may explain the limitation of extensive thrombosis and the favorable outcome in the majority of the patients.¹⁰ Cortical veins have thin walls, no muscle fibers, and no valves, thereby allowing a reversal of blood-flow direction. Moreover, they are potentially linked by numerous anastomoses facilitating the development of collateral circulation in cases of partial thrombosis.¹⁴ Evaluating treatment in patients with cortical vein thrombosis is difficult if we assume that many cases remain undiagnosed and have a spontaneous favorable evolution. Nevertheless, the current

practice of treating sinus venous thrombosis with heparin may logically also apply to cortical vein thrombosis.^{10,15,16} Three of our patients showed dramatic improvement with full-dose heparin, but a spontaneously good evolution cannot be ruled out. Although a hemorrhagic infarct was present on CT in one patient, there was no worsening of bleeding.

Our study emphasizes the diagnostic difficulties encountered in patients with isolated cortical vein thrombosis. In two cases, the diagnosis could not be confirmed before surgery or repeat angiography. A thorough work-up, including repeat angiography, may be necessary in suspect cases. Cortical vein thrombosis should be considered in stroke patients with particular clinical findings, such as acute neurologic deficit after epileptic seizure or headaches without increased intracranial pressure, and in patients with brain imaging abnormalities such as ischemic lesions in a nonarterial territory or with an early hemorrhagic component.

References

1. Raymond F. Thrombose des veines pariétales: ramollissement cérébral aigu. Aphasie. Contractures. Gazette des Hôpitaux 1880;1066.
2. Garcin R, Pestel M. Thrombophlébites cérébrales. Paris: Masson, 1953.
3. Yokota T, Ishiai S, Furukawa H. Pure agraphia of Kanji due to thrombosis of the Labbé vein. J Neurol Neurosurg Psychiatry 1990;53:335-338.
4. Cambria S. Infarctus cérébral hémorragique par thrombose de la veine de Labbé. Rev Neurol (Paris) 1980;136:321-326.
5. Rao KCVG, Knipp HC, Wagner EJ. Computed tomographic findings in cerebral sinus and venous thrombosis. Radiology 1981;140:391-398.
6. Gabrielsen T, Seeger J, Knake J, Stivill E. Radiology of cerebral vein occlusion without dural sinus occlusion. Radiology 1981;140:403-408.
7. Macchi P, Grossman R, Gomori J, Goldberg H, Zimmerman R, Bilaniuk L. High field MR-imaging of cerebral venous thrombosis. J Comput Assist Tomogr 1986;10:10-15.
8. Milandre L, Gueriot C, Girard N, Cherif A, Khalil R. Les thromboses veineuses cérébrales de l'adulte. Ann Méd Interne (Paris) 1988;139:544-554.
9. Ameri A, Bousser MG. Cerebral venous thrombosis. Neurol Clin 1992;10:87-111.
10. Bousser MG, Barnett HJM. Cerebral venous thrombosis. In: Barnett HLM, Mohr JP, Stein BM, Yatsu eds. Stroke: Pathophysiology, diagnosis and management. 2nd ed. New York: Churchill Livingstone, 1992.
11. Buonanno FS, Moody DM, Ball MR, et al. Computed cranial tomographic findings in cerebral sinovenous occlusion. J Comput Assist Tomogr 1978;2:271-290.
12. Moulin T, Crépin-Leblond T, Chopard JL, Bogousslavsky J. Hemorrhagic infarcts. Eur Neurol 1994;34:64-77.
13. McMurdo S, Brant-Zawadzki H, Bradley M. Dural sinus thrombosis study using intermediate field strength MRI. Radiology 1986;161:83-86.
14. Yasargil MG, Damur M. Thrombosis of the cerebral veins and sinuses. In: Newton TH, Potts DG, eds. Radiology of the skull and brain. Angiography. St. Louis: CV Mosby, 1974.
15. Easton J. Treatment of cerebral venous thrombosis. Cerebrovasc Dis 1993;3:329-332.
16. Einhäupl KM, Villringer A, Meister W, et al. Heparin treatment in sinus venous thrombosis. Lancet 1991;338:597-600.

Neurology®

The stroke syndrome of cortical vein thrombosis

K. Jacobs, T. Moulin, J. Bogousslavsky, et al.

Neurology 1996;47;376-382

DOI 10.1212/WNL.47.2.376

This information is current as of August 1, 1996

Updated Information & Services	including high resolution figures, can be found at: http://www.neurology.org/content/47/2/376.full.html
References	This article cites 12 articles, 0 of which you can access for free at: http://www.neurology.org/content/47/2/376.full.html##ref-list-1
Citations	This article has been cited by 11 HighWire-hosted articles: http://www.neurology.org/content/47/2/376.full.html##otherarticles
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.neurology.org/misc/about.xhtml#permissions
Reprints	Information about ordering reprints can be found online: http://www.neurology.org/misc/addir.xhtml#reprintsus

Neurology® is the official journal of the American Academy of Neurology. Published continuously since 1951, it is now a weekly with 48 issues per year. Copyright Copyright 1996 by Advanstar Communications Inc.. All rights reserved. Print ISSN: 0028-3878. Online ISSN: 1526-632X.

